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(71) Applicant (for all designated States except US): **BIO-PRINT AS** [NO/NO]; Gaupeveien 21, N-8515 Narvik (NO).

(72) Inventor; and
(75) Inventor/Applicant (for US only): **MATHIASSEN, Camilla** [NO/NO]; Homansbyveien 4, N-1389 Heggedal (NO).

(74) Agent: **ABC-PATENT, SIVILING. ROLF CHR. B. LARSEN A.S**; Brynsveien 5, N-0667 Oslo (NO).

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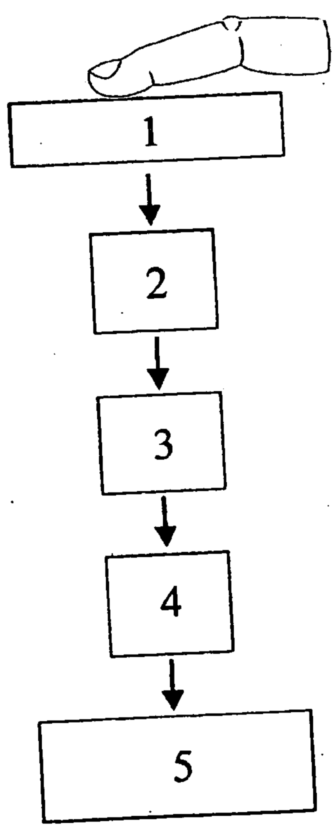

(57) Abstract: Sign generator for information or communication devices comprising at least one touch and/or pressure activated sensor and a display, the sensor being capable of measuring movements in two dimensions, analysing means connected to said sensor for categorising two dimensional movements sensed by the sensor according to a chosen set of categories, translating means including a predetermined table of categories of two dimensional movements corresponding to a chosen set of signs and indicating the chosen sign or signs on the display.

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Method and generator for inputting characters

This invention relates to a sign/character generator represented by a fingerprint sensor with navigation means, for text/sign input for communication and information devices with displays, such as cellular phones, palmtop PCs, PDAs, etc.

The compact size of such devices has reduced the dimensions of their keyboards. Such devices are therefore normally equipped with a keyboard as illustrated in fig. 1 where the number of keys are far less than the standard letters a user needs to input meaningful text. The solution for present cellular phones is to let each number key represent 3 or 4 subsequent letters as per fig. 1. For example the key usually giving number 6 will in the alpha-numeric mode define one of the letters m, n or o, pending the number of times the key is pressed. Thus the word "hello" may be written by pressing key number 4 twice, key number 3 twice, key number 5 thrice, key number 5 thrice and key number 6 thrice, thus pressing the keys a total of 13 times. The user needs to memorise the positions of these alphanumeric keys, or look up their positions and shift finger position from key to key, as per the above example. This makes text input by reduced keyboards a cumbersome and time-consuming effort.

There is a strong development trend of such handheld devices to make them increasingly smaller, lighter and yet cheaper. Yet their functionality continuously increases as they offer more information and data to the user, and therefore would benefit from larger displays. However, such increased displays should preferably not increase the overall dimensions of the already compact information/communication devices. Presently the two largest elements of the front panel of such information/communication devices are the display and the reduced keyboard, as per fig. 1, where generally the reduced keyboard still occupies more space than the display. The only efficient way to increase the display size without

increasing the overall dimensions of the device is to reduce the keyboard to a minimum size, as indicated in fig. 2 without loosing versatility and convenience of the text input process.

There are several known solutions to make the text input process based on current keyboard types as per fig. 1. One manufacturer, Ericsson, provides an external QWERTY keyboard as a plug-in device to their cellular phones. This solution has, however, the disadvantages of extra size, weight and costs, being directly contrary to user requirements for increasingly smaller, lighter, cheaper and more versatile cell phones.

Another known solution is the Nokia Naviroller™ in which a mechanical barrel on the front panel is rolled by the finger, bringing up a vertical column of signs and characters on the display. Selection of a particular sign or character is performed by mechanically pressing down the barrel. In practice this is not a faster solution than moving the finger from key to key and pressing the selected key one or multiple times. The Naviroller™ solution also imposes a serious constrain on the cursor movements as it limits cursor movements to one dimension; <up> and <down>, except for pressing the barrel for character selection.

Tegic Communications has developed a system called T9™ whereby software logic search for legal letter combinations of a particular language, thereby minimising the multiple presses of any key representing multiple characters, as shown in fig. 1. This is an elegant solution as the number of finger taps is presumably significantly reduced, but the negative aspect is that it requires a translation program for each language, and that these must be stored in the phone memory. Motorola is said to have developed a similar solution, called iTap™, thus having the same problems.

Generating text/character input on such reduced keyboards is therefore a slow and cumbersome process, even for alphabetic languages like the Latin language. However, a large part of the world's population uses sign-based languages, such as Chinese, Japanese, Korean, etc. Sign-based languages may comprise hundreds of thousands of signs,

aggravating the problem of text input by keyboards considerably.

A known solution for text input by sign-based languages is the Zi 8™ provided by ZiCorp, aimed at simplifying character input by Chinese signs through a limited keyboard as shown in fig. 1. It is based on the fact that Chinese signs are composed of so-called basic strokes, which sequence defines a particular sign. These basic strokes are assigned to the keys, much in a similar way as alphabet letters are assigned to the number keys, as illustrated in fig. 1. This solution enables input of Chinese characters by a reduced keyboard as per fig. 1, but does not resolve the main problems. A keyboard of considerable size is still required, but due to size limitations it normally contains far less keys than the characters/signs required to compose a meaningful message. The finger therefore has to be moved around the keyboard, and each key may need to be pressed down mechanically multiple times to select a message.

US 5,982,303 describes a joystick to feed characters, numbers and function categories into a processor. The method according to this publication may be use to write non-latin signs and to control a cursor. The publication mentions the use of eight keys for providing the control signals and represents a large and complicated solution. A similar solution is described in US 4,680,577.

It is an object of this invention to provide a simple solution for feeding information into a small unit, e.g. a cellular phone, by using sensors which have already been provided for other purposes.

US 5,088,070 describes the use of several dedicated switches on a wrist watch. Although it is more compact than the abovementioned solution it still represents an unnecessary large structure on the limited available space.

US 6,057,540 describes an optical sensor with navigation utilities. It's dimensions and complexity, however, makes unsuitable for usse in mobile phones and similar. Also, as the sensor described here preferably uses a 16x16 pixel matrix it is not suitable for use as a fingerprint sensor, since the resolution is unsufficient.

US 5,608,395 describes a telegraph key connected to a computer for writing text. The characters are organized in a hierarchy for demanding a minimum memory for choosing each character. This solution is also to complicated and large and does not have the advantage of using existing sensors in modile phones or similar.

The above illustrates the present situation for e.g. cellular phones, where complex text input is cumbersome as such input has to be generated through reduced keyboards as per fig. 1. The next generation of cellular phones comprises so-called WAP phones with Internet access. In general this development calls for increased displays, for better readability of more complex information. Preferably increased display size should not increase the cell phone size. The most viable way to increase display size without increasing the phone size will be to reduce the keyboard size, preferably to a one-button size, but still enabling complex text input to the cellular phone. None of the above solutions will function satisfactorily with such a single button "keyboard".

Thus it is an objective of this invention to provide a sign generator system for said information and communication devices. Such system shall enable complex text input in a fast and convenient way without requiring extensive program code loaded down in the device's memory, even for devices where the keyboard is replaced by a single button for character/sign entry. This objective is obtained by a sign generator based on combining a fingerprint sensor having navigation means, with analysing/interpreting means and translation means as described in claim 1.

The invention will be described below by way of example and with reference to the accompanying drawings.

Figure 1 illustrates a traditional reduced keyboard for e.g. cellular phones, with multiple-character keys.

Figure 2 exemplifies the front panel of a new generation of information and communication devices with a large display, obtained through a minimised keyboard.

Figure 3 illustrates the invention schematically.

Figure 4 illustrates categories of finger movements in

two dimensions.

Figure 5 illustrates text input for alphabetic languages, by the invention.

Figure 6 illustrates how mathematical operations can be handled on a palmtop PC by the invention.

Figure 7 illustrates schematically the hierarchy of strokes, components and Chinese signs as per ZiCorp's known solution, and how their Zi 8™ reduced strokes can be represented on a reduced keyboard.

Figure 8 tabulates stroke/sign hierarchy of Chinese signs.

Figure 9 illustrates in tabular form typical finger commands of the analysing/interpretation program, for Morse Mode and Display Mode text input to the cellular phone.

Figure 10 illustrates typical finger interfacing with the cellular phone.

The principle of the invention is illustrated schematically in fig. 3. A touch sensitive switch 1, in the form of a fingerprint sensor with navigation means, is coupled to analysing means 2. The analysing means measures the duration, direction and speed of finger moves on the switch, and categorises the signal from the switch into categories. The classified categories of data are stored in a memory 3 and are compared by a translation means 4 with predefined tables relating categories of finger moves and sequences thereof to readable characters/signs. The signs corresponding to these categories and sequences are then shown in the display 5 in a known manner. The form in which the data are presented on the screen, and how text input is interacted by the user is controlled by the translation means 4.

The switch 1 may in its simplest form be a simple on/off touch-sensitive switch. In this case the system will register the duration of the finger touches, as well as disconnect periods in order to distinguish between periods between the signals, periods between complete characters/signs and periods between words.

The connection categories may be selected by measuring the connection period t_m and comparing them t_{moff} with

predefined limits according to defined sets of finger commands. The system comprises lower and upper limits for being registered as a signal. Signals being shorter than the lowest limit defined as t_{reg} may be ignored to avoid errors caused by accidental touches of the switch 1 e.g. due to handling of the information/communication device. Connection periods longer than the predefined limits may also be ignored, or may be classified as a separate code, for example "End of message". In addition long disconnects may be registered as periods between signs. Table 1 defines typical time limits.

Table 1

Time Ranges	Nom. Values	Meaning	Type
$0{,}001s < t_{Reg} < 0{,}100s$	$t_{Reg} = 0{,}01s$	Reg. limit	Basic/Non-adapt
$1{,}5\ t_{Reg} < t_{off} < 50{,}0\ t_{Reg}$	$t_{off} = 0{,}25s$	Sign Sep.	Adaptive
$1{,}5\ t_{Reg} < t_{Short} < 50{,}0\ t_{Reg}$	$t_{Short} = 0{,}25s$	Dot	Adaptive
$1{,}5\ t_{Short} < t_{Long} < 5{,}0\ t_{Short}$	$t_{Long} = 0{,}50s$	Dash	Adaptive
$1{,}5\ t_{Long} < t_{Extra} < 10{,}0\ t_{Long}$	$t_{Extra} > 0{,}75s$	Period	Adaptive

The time limits of Table 1 above may of course be chosen otherwise. A particular embodiment of the invention is to set the above ranges dynamically to adapt to the user's skills and his learning curve in using the invention. This may be done by registering the e.g. 50 last commands of each type, and calculating the arithmetic mean and standard deviation. The statistics may be based upon any written text or a predetermined learning sequence, and may be used to shift the category definitions according to the speed of the user, and thus also adapt as the user learns the system and increases his input speed.

Although the touch-sensitive switch 1 in its simplest form could be a simple on and off switch, it would be insufficient compared to the objective of the invention. To provide combined user authentication by finger print biometrics, accurate cursor control and fast, versatile and flexible text input, all served by the very same single-button sensor, requires a sensor that can register lateral finger movements. The preferred embodiment of the invention

must therefore provide a fingerprint sensor with navigation means comprising capability also to register lateral finger movements on the switch. Patent publication EP 735.502 describes a line-shaped fingerprint sensor. This fingerprint sensor scans the fingerprint, and in order to analyse the finger print, is able to detect the finger movement across the sensor in one dimension; <Up> and <Down>. Such one-dimensional finger movement detection may be expanded to two-dimensional finger registering by arranging some of the sensor elements as per fig. 4. This may for example be obtained by using two orthogonal sensors of the type shown in the EP publication mentioned above. The figure illustrates categories of lateral finger movements that are used to build finger commands, either by basic finger movements, or combinations thereof. Fig. 4 defines ten lateral finger movement categories (in addition to vertical taps); eight directions of movements and two circular movements (clockwise and counter-clockwise). These may also be combined with time measurements to calculate the velocity of a movement, thus providing a number of differing categories from one single finger movement. All the finger movements (on/off sensor, vertical taps, lateral linear and circular movements), their duration and speed are categorised in the analysing/interpretation means 2.

Such a touch-sensitive switch comprising a finger print sensor with navigation means enables the invention to use comprehensive and intuitive sets of finger commands in the interpretation/translation means 4. Combined finger commands can be made from sequences of basic finger movements.

As the touch-sensitive switch will serve multiple purposes in a combined function, as per the objective of the invention, a finger command structure is required that is applicable to all functions to be served, including versatility of the input modes. Moreover the finger command structure must be intuitive within each mode, to avoid the need for memorising complex finger commands. Such a finger command structure is exemplified in Table 2 below. This finger command structure is a key element of the invention, and represents a basis for the translation means.

The analysing means can be set by finger commands to alternative modes, where the default is Display Mode, another will be Sign-based language input (e.g. Chinese signs), etc.

This embodiment of the invention, comprising a single-button input device for multiple input modes uses "universally defined" finger command structures embedded in the translation means, ensuring that the sign generator provides the required input type in the respective input modes of the information/communication devices. The input modes are arranged in a hierarchy. Level 1 is shown in Table 3a. This is the overall mode level, where input mode alternative is set by the information/communication device. There is a fourth mode in addition to the three modes shown in Table 3a, namely Sleep Mode for minimum power consumption while sensor do not need to be active.

Table 2 Finger Command Structure

Display Mode Commands			
Vertical Screen Input Commands (One-character wide vertical Selection Fields)		**Horizontal Screen Input Commands** (One-line high Command Fields or Option Fields)	
Select Character	<Double Tap>	Select Command/option	<Double Tap>
One position down	<Finger Down>	One line down	<Finger Down>
Scroll down	<Finger Down - Hold>	Scroll down	<Finger Down - Hold>
One position up	<Finger Up>	One line up	<Finger Up>
Scroll up	<Finger Up - Hold>	Scroll up	<Finger Up - Hold>

Screen Manipulation Commands			
Toggle to horizontal fields	<Slanted Down Left>	Shift vertical fields	<Finger Right/Left>
Toggle to vertical fields	<Slanted Up Right>	Shift horizontal fields	<Finger Up/Down>
Toggle to/from Edit Text Mode		<Extra Long Tap> - <Finger Down>	

Edit Text Commands			
Home of Text Field	<Slanted Up Left>	Toggle to/from Edit Mode	*See Screen Manip. Commands*
End of Text Field	<Slanted Down Right>	Mark ***n*** characters left	<Long Tap> + ***n*** <Short Taps>
Move one position left	<Finger Left>	Mark ***n*** words left	<Long Tap> + ***n*** <Finger Left>
Scroll left	<Finger Left - Hold>	Shift marked letters' case	<Long Tap>
Move one position right	<Finger Right>	Delete marked character(s)	<Extra Long Tap>
Scroll right	<Finger Right - Hold>	Copy marked character(s)	<Double Tap>
One line up	<Finger Up>	Paste marked character(s)	Two <Double Taps>
Scroll up	<Finger Up - Hold>	Insert space right of cursor	<Short Tap>
One line down	<Finger Down>	Write to right of cursor	*Exit Edit to Input Mode*
Scroll down	<Finger Down - Hold>		

Global Commands		Sign Language Commands
Shift Input Mode	<Circular Finger Move>	<Circular Finger Move> brings up Command Field w/ Sign Language Mode. <Double Tap> to select. Then use <Finger Down/Up> for Chinese, Japanese or Korean signs
Toggle Edit Text	*See Screen Commands*	
End of Text Input	Two <Extra Long Tap>	

Table 3a

MODE LEVEL 1

Automatically set by the Device

ACCESS CONTROL MODE	TEXT INPUT MODES	CURSOR CONTROL MODE
Fingerprint sensor used for User Authentication	See Table 3b "Mode Level 2"	For cursor navigation on display

Table 3b

MODE LEVEL 2

Text Input Modes,

User-selected by Finger Commands

	Input Categories			
	Alphabetic Languages		Sign-based Languages	Special Operations
Input Device	On Display by Finger Commands	Latin alphabet Greek	Chinese Japanese Korean	Mathematics
	Draw on Sensor directly	NA	Chinese Japanese Korean	

An important benefit of the invention is that it allows significantly increased display size (e.g. for WAP applications) as per fig. 2, as the larger keyboard of fig. 1 is replaced by a single sign-generator button supplemented by e.g. two function keys.

The most important benefit from the invention is,

however, that it provides full versatility and flexibility of input by a single-button multiple-function device. This is achieved by supporting a sensor with navigation means (due to its capability to register lateral finger movements as per fig. 4) with Finger Movement Categories defined in Table 1 combined with the Finger Command Structure per Table 2 and the Input Modes & Categories as per Tables 3a & 3b.

This versatility and flexibility of input by such a single-button key will be described by two examples. The first example comprises text input by Latin letters to e.g. a cellular phone with a large display and a minimum keyboard, as shown in fig. 2. The cellular phone will switch the single-button sign-generator system to the text input mode (Level 1 in Table 3a) as response to user selection of e.g. SMS (Short Message System). Thereby the translation means 4 arranges the display 5 typically as shown in fig. 5a comprising vertical selection field 8 and horizontal command field 9. The user may conveniently shift between the vertical and horizontal fields by finger commands <Slanted Down Left> and <Slanted Up Right> 10, as per the embedded Finger Command Structure in the translation means 4. In this example the user will use Latin letters and Arab numbers for the text input. This is the default text input mode, and the user does therefore not need to shift to the horizontal command field for change of input mode, but he can directly start generating text by finger commands to the vertical selection field 8. Fig. 5b illustrates a number of alternative character sets of the selection field in this mode. When he starts generating text the default set is capital Latin letters, displaying letter A in the marked middle position of the vertical selection field. Say the user first wants to input an E as the first character. He then moves his finger down and keeps it still on the switch 1. This starts scrolling the vertical selection field. When the character E has been brought to the marked middle position the user <Double Taps> on the switch, selecting the required letter E and printing it in the display 5. This selection automatically switches the character set of the vertical selection field to minor letters. The user then

wipes his finger up or down over the sensor, according to the position in the alphabet of the next required character. If he wants to move a single character, or just a few characters, he moves his finger once or several times up or down. If the next character is a larger number of positions away, he moves his finger in the desired direction and then holds the finger still on the switch to start scrolling in the desired direction. The scrolling halts when he lifts his finger from the switch 1. If the user needs other character sets, he simply gives finger commands 14 <Finger Left> or <Finger Right>, e.g. to insert numbers, special characters or to use capital letters again (e.g. for a name). Word separation may be done by finger command <Long Tap> and period ("punctum") may be entered as two consecutive <Long Taps>, etc. The user may at any time toggle to Edit Text Mode by finger command sequence <Extra long Tap> - <Finger Down> as per Table 2. End of Message may be given by finger command sequence comprising two consecutive <Extra Long Taps>.

Prior to this text input (when the device is switched ON) the device automatically sets the switch 1 to authentication mode for access control to the cellular phone. The user is then asked by text on the display to wipe his finger down over the sensor. When authentication by finger print biometrics is completed, the cellular phone sets the sign-generator to sleep mode, for energy saving. The sign-generator is then waked up e.g. when a request for the sign-generator is called for, e.g. by SMS input as per the above example. If the user wants to play a game on the device, its control system sets the switch 1 to Cursor Control Mode as per Table 3a. Two-dimensional finger moves combined with combined finger command sequences (such as taps, etc.) thereby gives an accurate cursor control combined with numerous command functions for quite complex games. This example demonstrates that the invention is capable of rendering full input versatility and flexibility even through a single-button sign-generator, thereby enabling the use of a large display as exemplified in fig. 2 still maintaining full functionality.

Yet another example of the versatility of the invention is illustrated in fig. 6. This example pertains to mathematical calculation on a palmtop PC, but may as well be embodied in cellular phones or PDAs. For such calculations the applicable Finger Command Structure set will be limited to taps on multiple selection fields as per Table 1, while lateral finger movements is reserved for cursor control. Fig. 6a illustrates a palmtop PC set to Calculation Mode (arithmetic) in which mode the display 5 contains another type of vertical selection field 16 and another horizontal selection field 17. The vertical selection field 16 contains all numbers from 0 to 9, plus decimal point (,) as illustrated in fig. 6b. The horizontal selection field 17 comprises in this mode the arithmetic operators (+, -, * , /) plus Clear All (C_{All}), Clear Memory (M_{Clear}), add to memory (M^+), subtract from memory (M^-), square root (v) and n^{th} power (n), etc as illustrated in fig. 6c. In this mode the lateral finger commands are mainly reserved for cursor control. This means that when the finger is moved laterally over the sensor 1, the cursor moves accordingly on the display 5. An arithmetic formula such as "972 * 3 = ?" is generated on the display 5 by moving the cursor by finger movements to the number "9" in the vertical selection field 16 and <Double Tap> for selection, cursor is then moved to "7" and selected, the cursor then moved to "2" and selected. The cursor is then moved by lateral finger command to the "*" sign of the horizontal field 17 and selected by <Double Tap>, then back to the vertical selection field 16 over number "3" and selected by <Double Tap>. The user then presses <Extra Long Tap> which produces "=" on the display, starts the calculation and prints the result "2.916" on the display. Other character subsets of the vertical selection field 16 may be incorporated. Navigation by fingerprints inside the selection fields may be initiated by finger command <Short Tap> when cursor is positioned within the vertical selection field to temporarily disengage the cursor control by finger commands. Then the user may shift character sets of the vertical selection field 16 by <Finger Left> or <Finger Right> commands (as per fig. 5b). When the

new character set has been activated the cursor control by lateral finger commands on the switch 1 can be re-engaged by pressing another <Short Tap>. The horizontal selection field may in the same way be changed to other subsets of mathematical operators. This is done by placing the cursor in the horizontal selection field, pressing <Short Tap> to disengage the cursor control, use finger commands <Finger Up> or <Finger Down> to select other subsets, and finally to re-engage the cursor control by pressing <Short Tap>. This embodiment of the invention enables a versatile and flexible handling of calculation mode on the display, still operated by a single-button switch 1.

While the Latin alphabet contains around 30 standard letters, sign languages are composed of hundreds of thousands of signs though some of them may be rarely used. The large number of such signs compared to the number of standard alphabetic letters represents a major problem of representing such signs by multiple signs per key of a reduced keyboard, in the same way as for alphabetic letters as illustrated in fig. 1. Key-representation of e.g. Chinese signs is normally resolved by representing so-called basic strokes to the keys. Chinese signs may then be composed of strictly defined sequences of basic strokes. ZiCorp has taken this a step further introducing eight reduced strokes denoted Zi 8™ that represents the 29 basic strokes. The hierarchy of reduced Zi 8™ strokes, basic strokes, components and Chinese signs is illustrated in fig. 7a, while fig. 7b shows how the eight Zi 8™ reduced stokes can be assigned to a reduced keyboard. Fig. 8 shows the relations between Zi 8™ reduced strokes, 29 basic strokes and some full Chinese signs. This enables Chinese signs to be entered as input through a reduced keyboard. However, this is an even slower and more cumbersome process than typing alphabetic letters, as the Chinese signs are generated through the hierarchy illustrated in fig. 7a.

The invention, based on a sensor capable of registering lateral finger moves combined with categories of finger movements and their sequences (embedded in the interpretation/analysing means) and finger command structure

(embedded in the translation means) enables a very efficient methods of signs for sign-based languages. This can be accomplished in two manners that will be explained below by reference to figures. The first sign input method is by selection of signs from selection fields at the display. This is illustrated in fig. 9. The display 5 is shown with a Chinese text string generated on the display. It has been generated by selecting characters in a hierarchical manner from a vertical selection field 18, supported by a horizontal supplementary field 19. The vertical selection field 18 comprises several subsets of characters; One set is the Zi 8™ reduced strokes 20, another subset is the 29 basic strokes 21 and a third subset is complete Chinese signs 22. A fourth character subset comprises stroke components 23. Shifting between these character subsets is performed by finger commands <Finger Left> and <Finger Right>, in the same manner that was explained in fig. 5b. These character subsets provide the same hierarchy of strokes, components and signs as illustrated in fig. 7a. The reason is that the complete sign subset 22 would contain hundreds of thousands of signs, and sign selection from such a large subset would be utterly inefficient. By the illustrated method of fig. 9 the user may first select a basic stroke from the Zi 8™ reduced strokes subset 20. This then limits the contents of the basic stroke subset to those pertinent (as per fig. 8). Selection of the wanted basic stroke is performed from subset 21. This selection in turn limits the subset of complete signs 22 to those pertinent, so that selection of the final sign is convenient, as it has been limited to only viable signs to a maximum extend. As an intermediate step stroke components can be selected from character subset 23. The user may be finger commands <Finger Left> or <Finger Right> go start directly on subset 21 comprising the basic strokes, to eliminate one level of the hierarchy shown in fig. 7a. Navigating in the vertical selection field 18 and character selection within this field is performed by finger commands exactly as explained by fig. 5. This is performed by finger commands <Finger Up> or <Finger Down> followed by <Double Tap> when the appropriate character is in marked

position. Scrolling is also performed the same way as in fig. 5 by moving the finger up or down, and then holding it still on the sensor. The horizontal supplementary field 19 is used for temporary display when building up complete signs by strokes, and for displaying alternative sign candidates as more strokes are entered. This enables rapid selection of the final sign even before the complete number of basic strokes or components have been selected from the vertical selection field 18.

This embodiment of the invention is further explained with reference to fig. 10, illustrating entry of the example text string "Don't forget to transfer at Mong Kok" by Chinese signs. This example is taken from ZiCorp's illustration of its Zi 8™ method. First the "SMS" mode is activated by finger command <Circular Finger Move> 25 on the switch 1. This brings up the entry text (e.g. "Message") on the display 5. The intermediate steps will be further illustrated by fig. 11, but fig. 10 shows the final stage where two consecutive <Extra Long Taps> have given the command "End of Message". This initiates the "Send Message" mode, as illustrated in fig. 10b. This brings up a special horizontal selection field 27 containing numbers 0 through 9 plus the international trunk code prefix "+" (not shown in 27). The user generates digits for the phone number by finger commands <Finger Left> or <Finger Right> 26 in the selection field 27, and <Double Tap> on the wanted number. This sequence is repeated until the complete number is generated in the horizontal display field 28. Editing of this number can be performed by finger commands for editing exemplified in Table 2. When the complete number is generated the user accepts, and thereby starts transmission of the SMS message by pressing function button 7, indicated by "Send" in the display 5. The intermediate steps of generating the text string itself are illustrated by fig. 11. Fig. 11a illustrates how the text generating modes by Chinese signs brings up the vertical selection field 20 (Zi 8™ character subset) and the horizontal supplementary field 19 are brought up on the display 5. The user selects the appropriate Zi 8™ reduced sign by <Finger Up> or <Finger

Down> until the wanted reduced sign "over" (per Table 8) is marked and then <Double Taps>. Thereby the reduced stroke "over" is shown in the display 5. In fig. 11b the user continues to select the reduced stroke "left slope" (as per fig. 8) by finger move and <Double Tap>. This brings up the reduced sign "left slope" on the display 5. In fig. 11c the user has selected the reduced stroke "down" by similar finger commands. This last reduced stroke selection has at the same time narrowed down the candidate signs to a smaller number, and these candidates are displayed in the horizontal supplementary field 19. The user may now change from the vertical selection field 20 to the horizontal supplementary field 19 by finger command "Slanted down left" and then by finger command bring the cursor over the wanted sign (actually the first sign in the horizontal field 19) and then <Double Tap> for selection. This choice replaces the three reduced strokes from the display 5 by the selected sign, as per fig. 11d. As this action empties the horizontal supplementary field 19, the cursor is automatically brought back into the vertical selection field 20, so the user does not have to give finger command <Slanted Up Right>. Fig. 11e shows selection of a component, which is brought up in the display 5 by accepting by <Double Tap> in the horizontal supplementary field 19 in fig. 11f. A similar procedure is repeated until the complete message is generated, as per fig. 11g. Editing of the message can be done by finger commands as listed in Table 2. By finger command two consecutive <Extra Long Taps> the user signals that the message is complete, which automatically generates a display organisation as per fig. 10b. As stated above the user can by finger commands <Finger Left> of <Finger Right> shift from the Zi 8™ reduced stroke character subset 20 to basic stroke subset 21. This enables more scrolling in the vertical selection field 21, but simplifies the procedure as one level in the hierarchy per fig. 7a is eliminated.

The preferred embodiment of the invention is, however, to draw the basic strokes (or reduced strokes) directly on the switch 1, having ability to register lateral finger movements as per fig. 4. This only requires a dedicated

category of finger movements, and their sequences, embedded for a special mode that is direct input of the strokes on the switch 1. The two modes "Draw strokes directly on sensor" and "Generate strokes from selection field" can be operated interactively. The finger movements for drawing the strokes directly on the sensor associated with reduced strokes and basic strokes respectively, are shown in Table 4.

Table 4

Finger Commands in Sign Language Mode (Chinese)

Finger Command on Sensor	**Type**	**Reduced Stroke (Zi 8™)**	**Basic Strokes**
Finger skew down left	Primary	Left Slope Stroke (Keypad 1)	Left Slope Stroke (Keypad 1)
Finger move to right	Primary	Over Stroke (Keypad 2)	Over Stroke (Keypad 2^1)
Finger skew up right	Primary	Not defined	Lift Stroke (Keypad 2^2)
Short tap	Time-related	Dot Stroke (Keypad 3)	Dot Stroke (Keypad 3^1)
Finger skew down right	Primary	Not defined	Right Slope (Keypad 3^2)
Down - Right	Composite	Down - Over Stroke (Keypad 4)	Down - Over Stroke (Keypad 4^1)
Skew down left - Right	Composite	Not defined	Left Slope - Over Stroke (Keypad 4^2)
Skew down left -- Skew down right	Composite	Not defined	Left Slope - Dot Stroke (Keypad 4^3)
Down - Skew up right	Composite	Not defined	Down Hook Stroke (Keypad 4^4)
Down - Skew down right - Skew up left	Composite	Not defined	Right Slope - Hook (Keypad 4^5)
Skew down right - Right - Skew up left	Composite	Not defined	Over - Hook (Keypad 4^6)
Down - Right	Composite	Not defined	Down - Over (Keypad 4^7)
Down - Right - Skew up left	Composite	Not defined	Down Over - Hook (Keypad 4^8)
Skew down left - Right - Skew down left	Composite	Not defined	Down Over - Left Slope (Keypad 4^9)

Down - Right - Down - Left	Composite	Not defined	Down Over - Down Hook (Keypad 4^{10})
Down - Right - Down	Composite	Not defined	Down Over - Down (Keypad 4^{11})
Finger down	Primary	Down Stroke (Keypad 5)	Down Stroke (Keypad 5^1)
Down - Left	Composite	Not defined	Down - Hook (Keypad 5^2)
Right - Skew down left	Composite	Over - Hook Stroke (Keypad 6)	Over - Hook Stroke (Keypad 6^1)
Right - Down	Composite	Not defined	Over - Down Stroke (Keypad 6^2)
Right - Down - Skew up left	Composite	Not defined	Over - Down - Hook Stroke (Keypad 6^2)
Right - Skew down left	Composite	Not defined	Over - Left Slope Stroke (Keypad 6^4)
Right - Down - Right - Skew down left	Composite	Not defined	Over - Down Over - Left Slope (Keypad 6^5)
Right - Down - Skew down right - Down - Skew up left	Composite	Not defined	Over - Down - Curved Hook (Keypad 6^6)
Right - Down - Right - Down - Skew up left	Composite	Not defined	Over - Down - Curved Hook (Keypad 6^6)
Skew down right - Left	Composite	Curved Hook Stroke (Keypad 7)	Curved Hook Stroke (Keypad 7)
Right - Down - Skew up right	Composite	Over - Down - Hook Stroke (Keypad 9)	Over - Down - Hook Stroke (Keypad 9^1)

Right - Down - Right	Composite	Not defined	Over - Down - Over (Keypad 9^2)
Right - Down - Skew up left	Composite	Not defined	Over - Down - Lift (Keypad 9^3)

The preferred embodiment of the invention as described above gives the following major advantages compared to other known solutions;

- The touch-sensitive switch 1 with navigation means provides a single-button input device with multiple functions, as it combines fingerprint scanning for user authentication for access control, with touch-pad functionality for navigating a cursor on the display, and with versatile and flexible input capability due to the embedded Finger Command Structure as per Table 2.
- The touch-sensitive switch 1 with navigation means and embedded Finger Command Structure enable input of signs for sign-based languages (such as Chinese) either by selection of strokes or components from selection fields in the display, or by drawing the strokes directly on the sensor. The latter provides a very direct and highly efficient text input method for sign-based languages.
- The embedded Finger Command Structure enables a highly flexible input means, as the user may freely switch between multiple input modes such as input by Morse code, selection of characters and signs from display selection fields, or direct drawing of strokes or components on the sensor. This can be accomplished by Finger Commands without requiring changes of set-up between the various input modes.

C l a i m s

1. Sign generator for information or communication devices comprising at least one touch and/or pressure activated fignerprint sensor and a display, the sensor being capable of measuring movements in two dimensions,
analysing means connected to said sensor for categorising two dimensional movements sensed by the sensor according to a chosen set of categories,
translating means including a predetermined table of categories of two dimensional movements corresponding to a chosen set of signs and indicating the chosen sign or signs on the display.

2. Sign generator according to claim 1, comprising a time measuring device for measuring the duration of the movements, and the periods between them, said categories including information of the duration.

3. Sign generator according to claim 2, wherein the set of categories comprises the Morse alphabet.

4. Sign generator according to claim 1, wherein the set of categories comprises linear movements in at least eight directions and two circular movements, clockwise and counter-clockwise.

5. Sign generator according to claim 1, wherein the sensor is a fingerprint sensor.

6. Sign generator according to claim 1, wherein the categories are ordered in a hierarchy, the first categorised finger movement thus selecting a first set of signs, the second categorised movement selecting a sign or subgroup from the first set of signs.

7. Sign generator according to claim 6, wherein the hierarchy has at least three levels.

8. Sign generator according to claim 6, wherein the categories define a Chinese sign set.

9. Sign generator according to claim 1, wherein at least two of the categorised movements is related to a control signal for the display, said display indicating a list of signs and said control signal indicating scrolling and choosing in said list.

10. Method for using a sign generator according to any one of the preceding claims, measuring omni-directional finger movements across the sensor in two dimensions,

using the analysing means for categorising omni-directional finger movements across the sign generator according to predefined sets of finger movement sequences including directional and touch/no-touch finger movement sequences,

using the translating means including uniquely defined command table for translating the categorised finger movements into signals controlling the display as results of the finger movements on the sensor.

11. Method according to claim 10, wherein the categories are ordered in a hierarchy, a first categorised finger movement thus selecting a first set of signs, the second categorised movement selecting a sign or subgroup from the first set of signs.

12. Method according to claim 11, wherein the hierarchy has at least three levels.

13. Method according to claim 11, wherein the categories define a Chinese sign set.

14. Method according to claim 10, wherein the finger movements control cursor movements on the display within the selected table of characters, signs or commands.

15. Method according to claim 14, wherein at least one finger movement controls the selection of the desired character, sign or command which the cursor has been moved to within the selected table.

16. Method according to claim 10, wherein at least two of the categorised movements is related to a control signal for the display, said display indicating a list of signs and said control signal indicating scrolling and choosing in said list.

17. Sign generator system for information/communication devices, comprising a combination of a touch-sensitive fingerprint sensor with navigation means coupled with analysing means containing sequenced categories of finger commands and coupled to a translation means including a Finger Command Structure, providing full versatility in stroke input for sign-based languages either by stroke selection from display selection fields or by drawing the strokes or components directly on the sensor.

Fig. 3

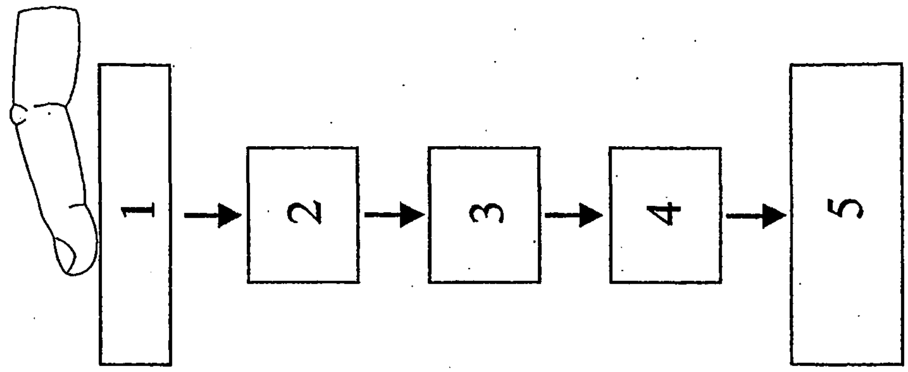


Fig. 2

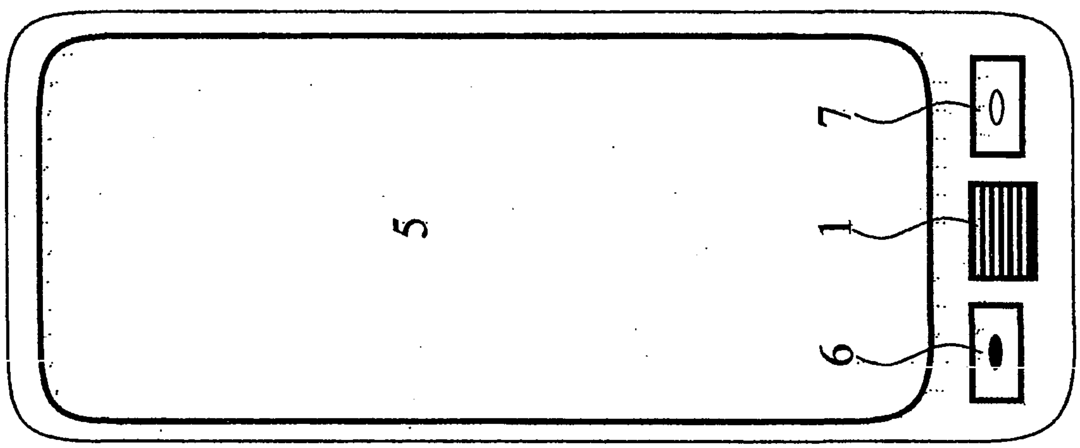


Fig. 1

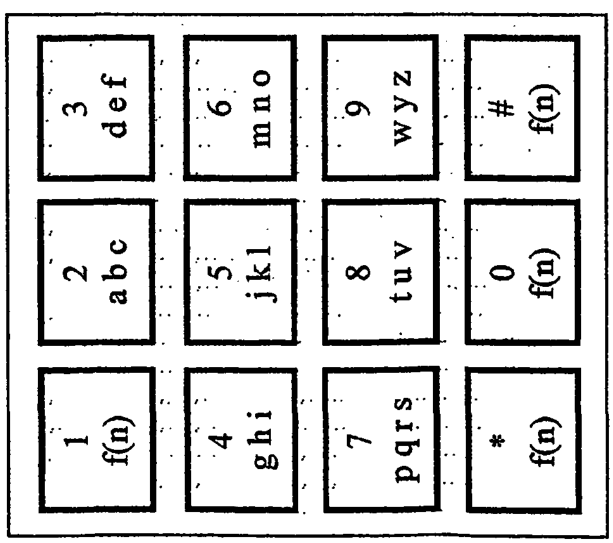


Fig. 4

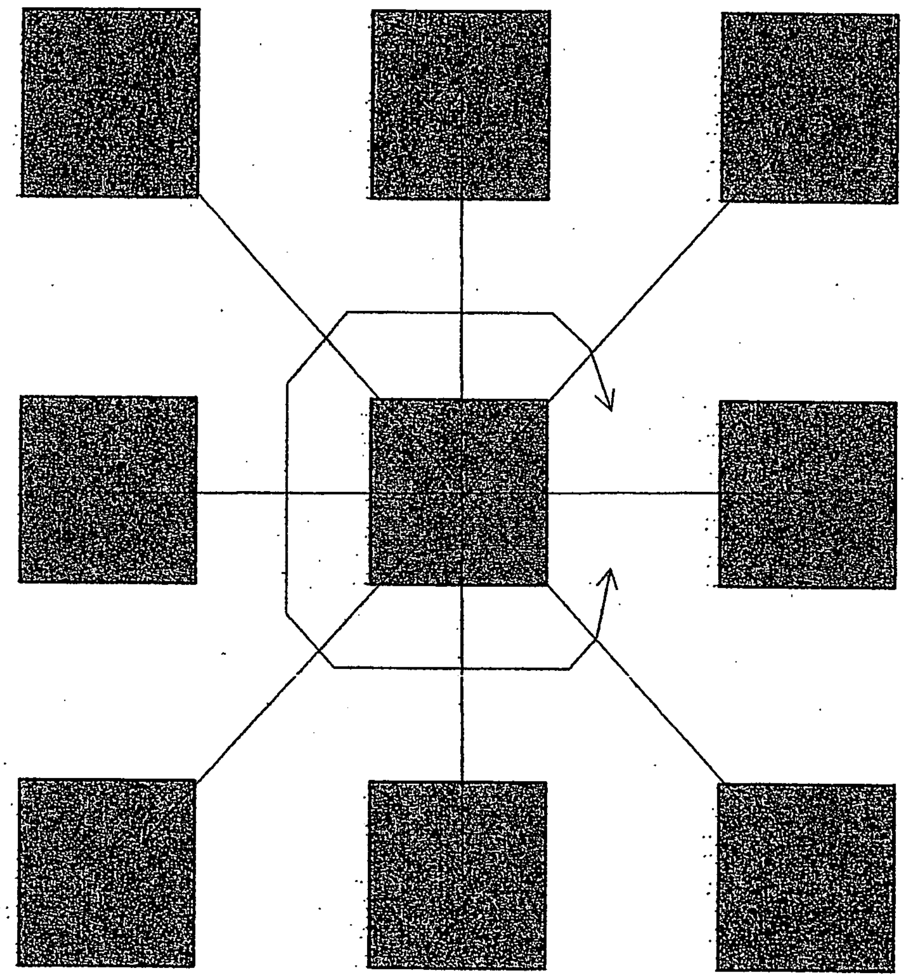


Fig. 5

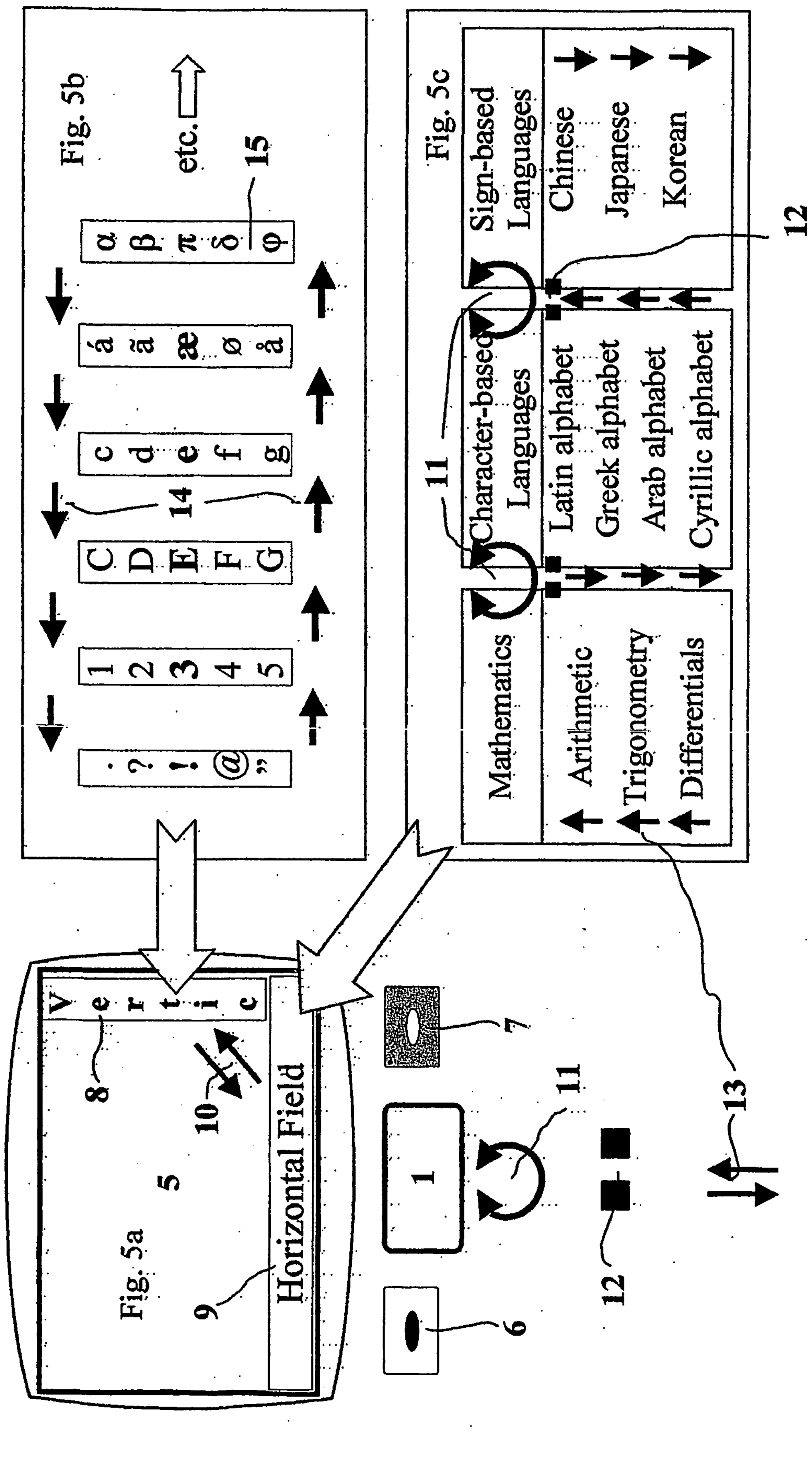


Fig. 5a
Vertic
Horizontal Field
5
8
9
10
1
6
7
11
12
13
Fig. 5b
. ? ! @ ,,
1 2 3 4 5
C D E F G
c d e f g
á ã æ ø å
α β π δ φ
etc.
14
15
Fig. 5c
Mathematics
Arithmetic
Trigonometry
Differentials
Character-based Languages
Latin alphabet
Greek alphabet
Arab alphabet
Cyrillic alphabet
Sign-based Languages
Chinese
Japanese
Korean
11
12

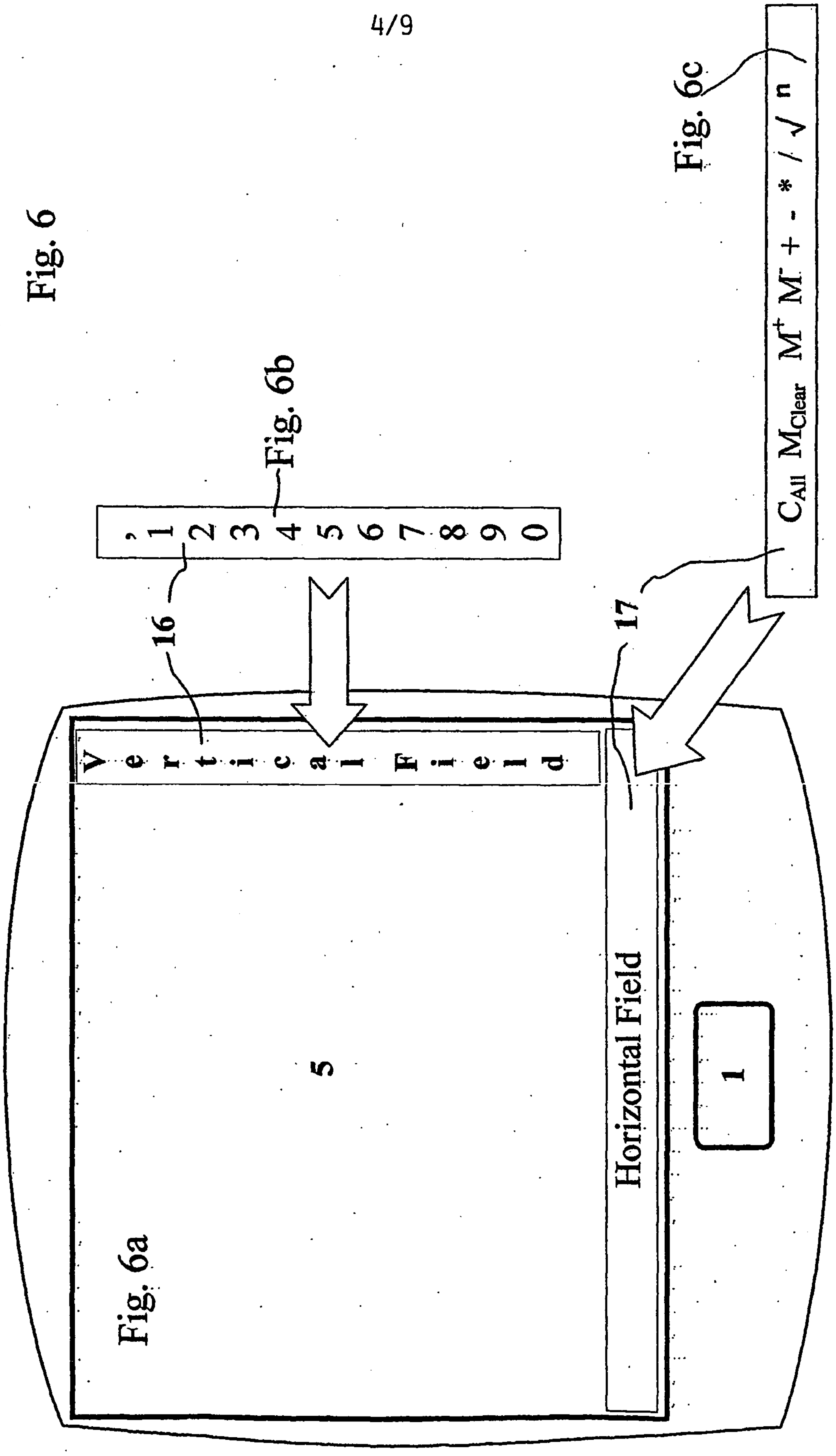


Fig. 6a
Fig. 6b
Fig. 6c
, 1 2 3 4 5 6 7 8 9 0
C_{All} M_{Clear} M^+ M^- + - * / √ n
16
17
Vertical Field
Horizontal Field
5
1

Fig. 6

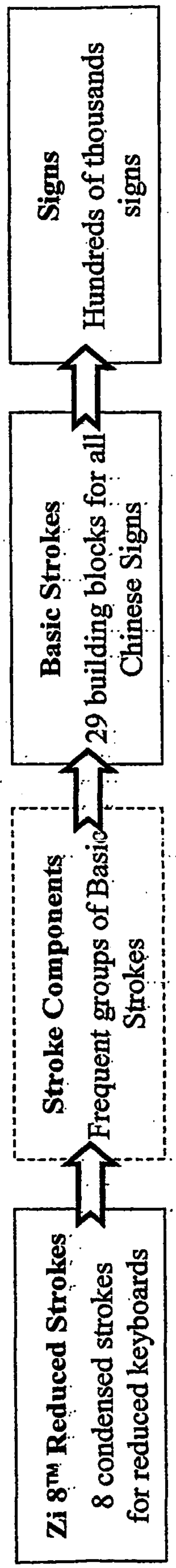

Zi 8™ Reduced Strokes
8 condensed strokes for reduced keyboards
Stroke Components
Frequent groups of Basic Strokes
Basic Strokes
29 building blocks for all Chinese Signs
Signs
Hundreds of thousands signs

Fig. 7a

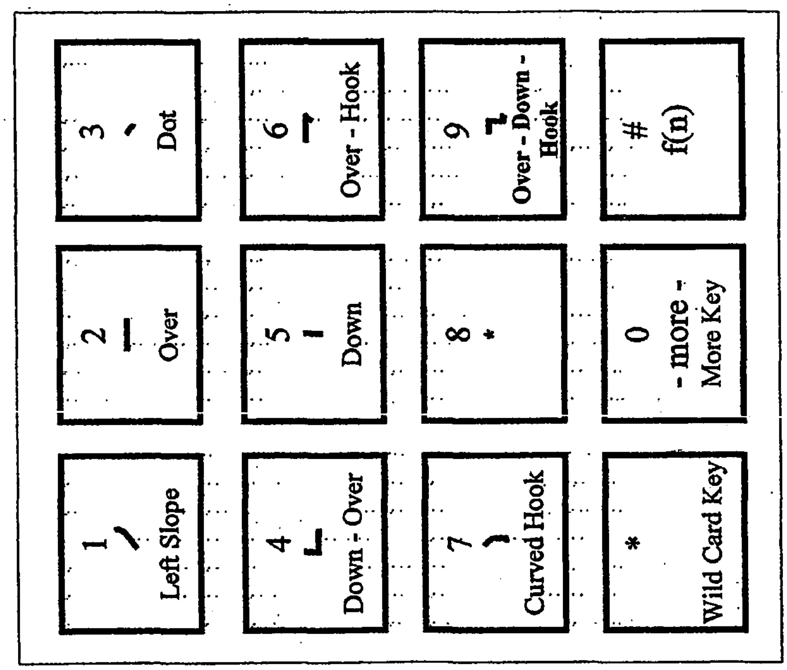
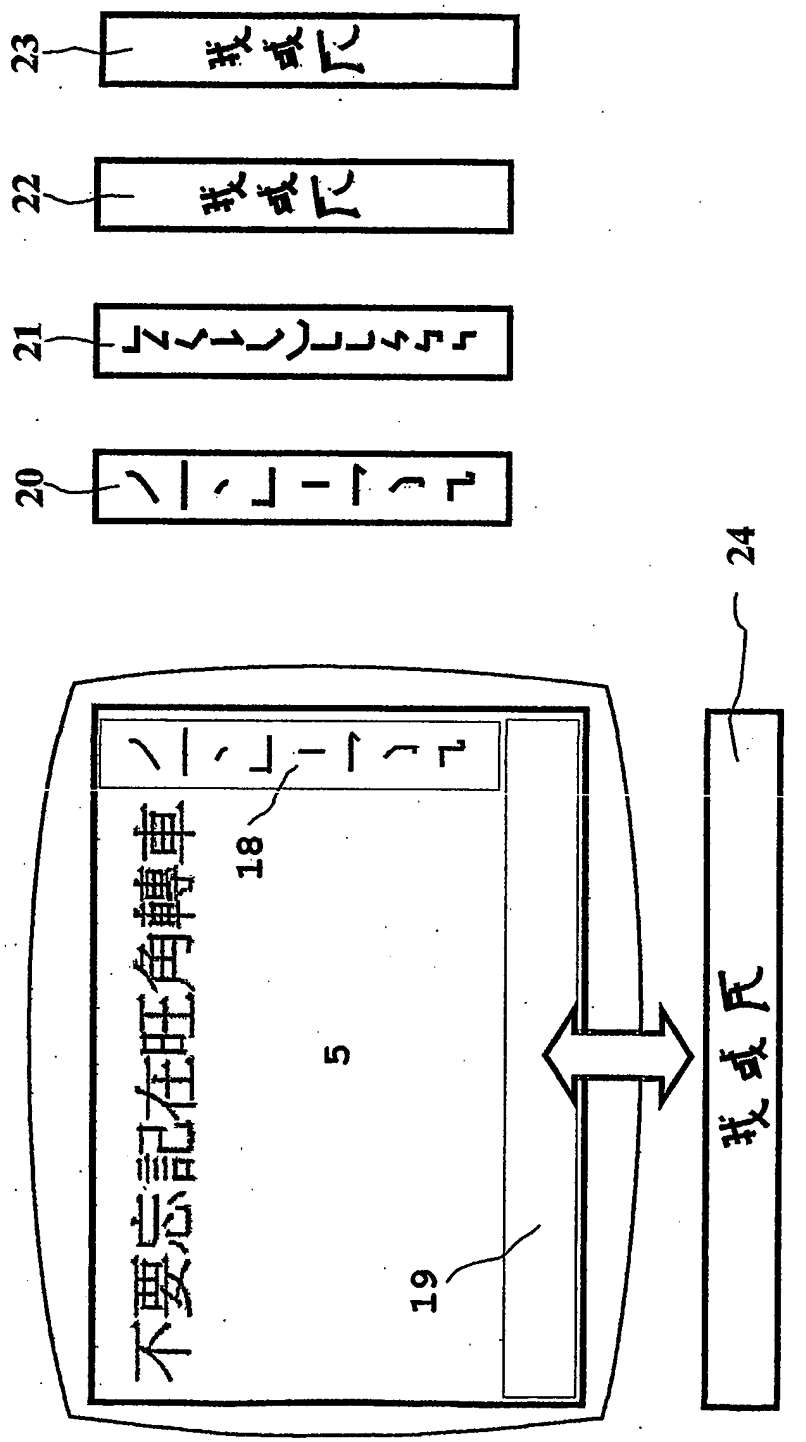

1
Left Slope
2
Over
3
Dot
4
Down - Over
5
Down
6
Over - Hook
7
Curved Hook
8
9
Over - Down - Hook
*
Wild Card Key
0
- more -
More Key
#
f(n)

Fig. 7b

Fig. 8

Keypad Location	Zi 8™ Stroke	Basic Stroke	Stroke Name	Characters
1	㇒	㇒	Left Slope	八 依 所
2	一	一	Over	王 十 在
		㇀	Lift	头 红 习
3	㇔	㇔	Dot	六 学 卅
		㇏	Right Slope	人 八 丈
4	㇗	㇗	Down - Over	山 巨 电
		㇜	Left Slope - Over	去 约 能
		㇛	Left Slope - Dot	女 巡 業
		㇙	Down Hook	衣 以 如
		㇂	Right Slope - Hook	我 或 民
		㇃	Over - Hook	心 必
		㇄	Down - Over	四 西
		㇟	Down Over - Hook	巴 也 毛
		ㄣ	Down Over - Left Slope	专
		㇉	Down Over - Down Hook	且 与 张
		㇞	Down Over - Down	鼎
5	丨	丨	Down	中 上
		亅	Down - Hook	小 水 打
6	㇖	㇖	Over - Hook	马 于 皮
		㇕	Over - Down	口 巳 户
		㇆	Over - Down - Hook	包 力 羽
		㇇	Over - Left Slope	又 之 社
		㇋	Over - Down - Over - Left Slope	及 丑
		㇌	Over - Down - Curved Hook	队 那 [illegible]
		㇡	Over - Down - Over - Down - Hook	乃 扔 杨
7	㇁	㇁	Curved Hook	车 狗 豹
8	Wild Card Key	*	Undefined strokes	
9	㇈	㇈	Over - Down - Hook	飞 九 风
		㇍	Over - Down - Over	投 船 凹
		㇊	Over - Down - Lift	语 计 认
0	More Key	etc., etc.	More optional characters	

Fig. 9



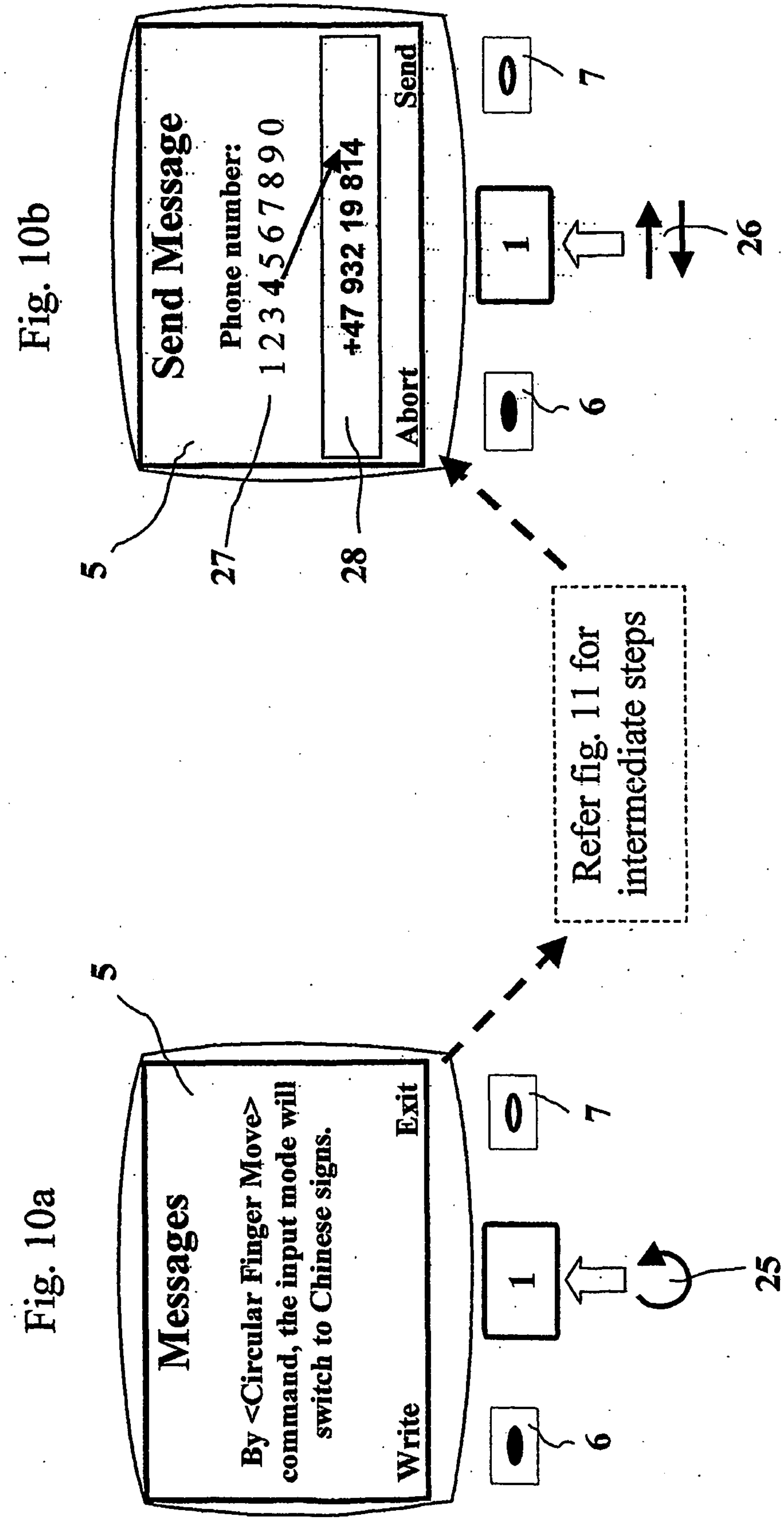


Fig. 10a

Fig. 10b

Fig. 10

Fig. 11

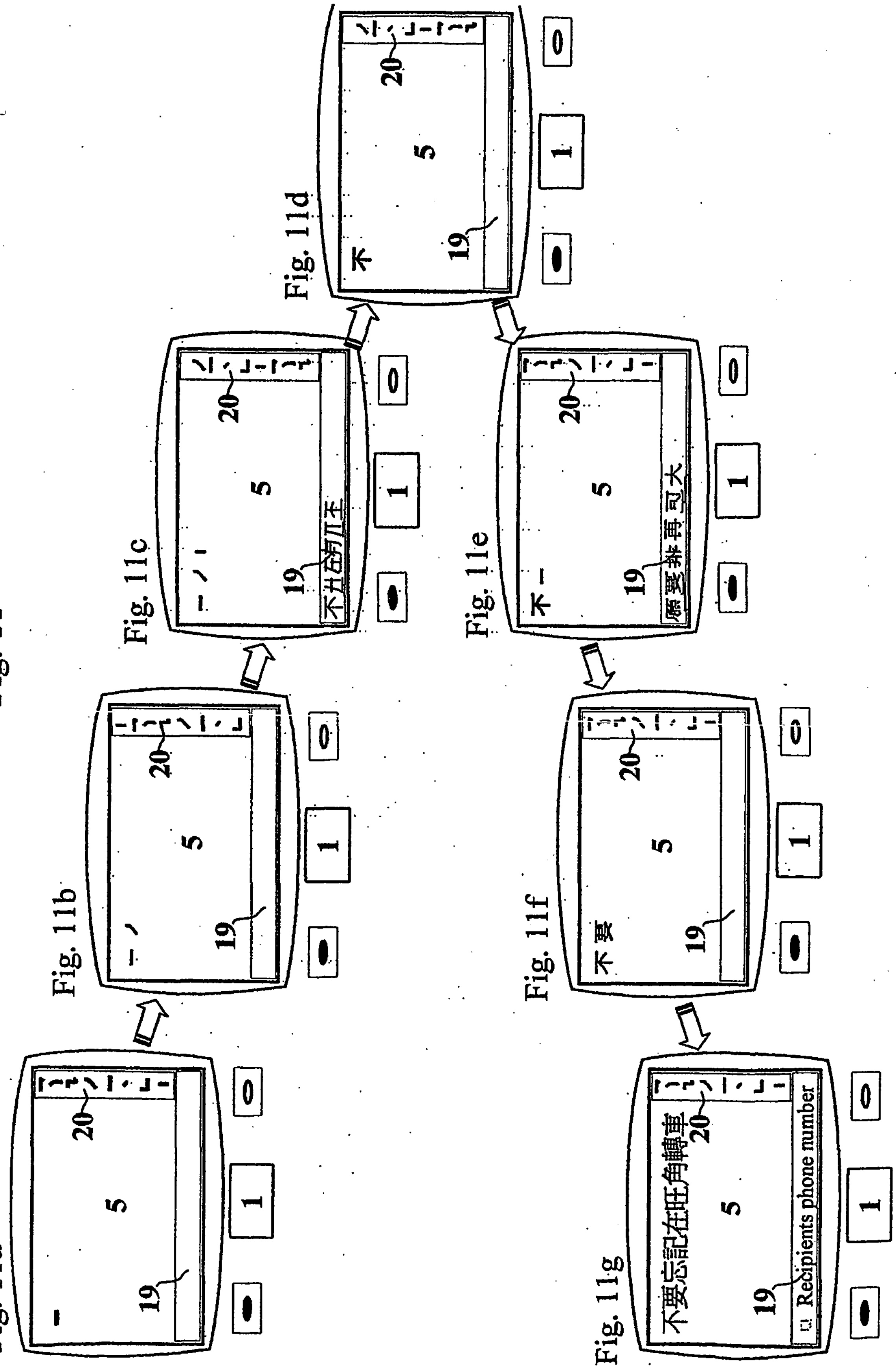


Fig. 11a
Fig. 11b
Fig. 11c
Fig. 11d
Fig. 11e
Fig. 11f
Fig. 11g
不要忘記在旺角轉車
Recipients phone number

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 01/00385

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: G06F 3/00, H04M 1/247
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: G06F, G06K, H04B, H04M, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5608395 A (KURTZ ET AL), 4 March 1997 (04.03.97), column 2, line 9 - column 7, line 12, figures 1-2, abstract --	1-17
Y	US 6057540 A (GORDON ET AL), 2 May 2000 (02.05.00), column 2, line 57 - column 9, line 67, figures 1-2, abstract --	1-17
Y	EP 0973123 A1 (LUCENT TECHNOLOGIES INC.), 19 January 2000 (19.01.00), column 1, line 25 - column 5, line 50, figures 1-3, abstract --	1-17

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
31 January 2002	05-02-2002
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Roland Landström/js Telephone No. +46 8 782 25 00

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0929028 A2 (STMICROELECTRONICS, INC.), 14 July 1999 (14.07.99), column 2, line 16 - column 7, line 39, figures 1-6, abstract --	1-17
Y	EP 0969644 A1 (NOKIA MOBILE PHONES LTD), 5 January 2000 (05.01.00), column 1, line 36 - column 8, line 12, figures 1-5, abstract --	1-17
Y	EP 0924948 A1 (SIEMENS AKTIENGESELLSCHAFT), 23 June 1999 (23.06.99), column 1, line 46 - column 2, line 42, figure 1, abstract --	1-17
Y	DE 19528734 A1 (SIEMENS AG), 6 February 1997 (06.02.97), column 1, line 1 - column 2, line 10, figures 1-7, abstract --	1-17
Y	EP 0927949 A2 (SAMSUNG ELECTRONICS CO. LTD.), 7 July 1999 (07.07.99), column 1, line 53 - column 10, line 53, figures 1-5b, abstract --	1-17
Y	US 4758979 A (CHIAO-YUEH), 19 July 1988 (19.07.88), column 1, line 35 - column 10, line 50, figures 1-4, abstract --	1-17
Y	US 5977948 A (NISHIBORI), 2 November 1999 (02.11.99), column 2, line 5 - column 9, line 34, figures 1-22, abstract -- --------	1-17

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/NO 01/00385

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		TW 403932 B	00/00/00
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